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An American National Standard

Standard Guide for Shipboard Generated Waste Management Audits[1]

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1. Scope

1.1 *Purpose*—This guide covers information for assisting shipowners in planning for costs or scheduling complications during maintenance, repair, modifications, purchase negotiations, or scrapping activities. Removal and disposal of certain materials disturbed during modification, maintenance, or disposal of systems or components may be costly or interrupt the work schedule.

1.2 *Objectives:*

1.2.1 This guide will describe materials that may be disturbed on ships during maintenance or scrapping activities, which may result in costly or time-consuming removal or disposal actions.

1.2.2 This guide will provide a systematic method to identify and record the locations of materials of concern for immediate planning and future reference.

1.2.3 This guide will include a brief discussion of issues related to the handling and storage of materials described in this guide.

1.3 *Considerations Beyond Scope:*

1.3.1 This guide is not intended to address materials carried as cargo or material stored onboard in prepackaged containers.

1.3.2 This guide is not intended to address waste products related to the ongoing, day-to-day operation of a ship, such as sewage, solid waste, incinerator ash (or other residual products resulting from solid waste treatment), and residual sludge left in segregated ballast tanks.

1.3.3 This guide does not provide a comprehensive index of test methods available for characterizing the materials discussed. Test methods referenced or described should be considered as examples.

1.3.4 This guide is not intended to address directly regulatory issues for any of the materials described.

1.3.5 This guide is not intended to address remediation concerns.

1.4 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D923 Practices for Sampling Electrical Insulating Liquids

E849 Practice for Safety and Health Requirements Relating to Occupational Exposure to Asbestos (Withdrawn 1991)[3]

2.2 *ASHRAE Standards:*[4]

ASHRAE Guideline 3 Reducing Emission of Fully Halogenated Chlorofluorocarbon (CFC) Refrigerants in Refrigeration and Air-Conditioning Equipment and Applications

2.3 *EPA Methods:*[5]

EPA 600/M4-82-020 Interim Method of the Determination of Asbestos in Bulk Insulation Samples

EPA SW-846, Method 8080 Organochlorine Pesticides and PCBs

EPA SW-846, Method 1311 Toxicity Characteristic Leachate Procedure

EPA SW-846, Method 8270 Semi-Volatiles List

EPA SW-846, Method 8260 Volatiles List

[1] This guide is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.06 on Marine Environmental Protection.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, http://www.ashrae.org.

[5] Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, http://www.epa.gov.

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *audit, n*—a process to identify waste materials associated with maintenance, repair, modifications, purchase negotiations, or scrapping activities, some of which may be hazardous, with the goal of providing planning information about environmental, health, and safety risks and related costs.

3.1.2 *friable, n*—a physical state in which a dry material can be easily crumpled, pulverized, or reduced to powder by hand pressure.

3.1.3 *mobile, adj*—capable of being transported from one surface to another.

3.1.4 *PCB, n*—a class of chemicals comprised of polychlorinated biphenyls.

3.1.5 *streaming agents, n*—a type of chemical used to fight small, contained fires by directing the firefighting agent specifically at the fire.

3.1.6 *target materials, n*—specific materials that the audit process will identify for evaluation.

3.1.7 *waste oil, n*—oil that cannot be reused or recycled.

4. Significance and Use

4.1 *Applicability*—This guide is intended to describe a planning audit that will improve the shipowner's ability to forecast costs and schedule impacts and aid the shipowner in identifying environmental, health, and safety concerns associated with the removal, handling, and disposal of potentially hazardous shipboard materials.

4.2 *Use*—Audits may be performed to aid in planning for a variety of events, including maintenance, repair, modification, purchase, or scrapping. To maximize efficiency, audits should be tailored to meet the specific needs of the shipowner, with target materials identified during the planning process.

4.3 *Caution*—Legal restrictions on the removal and disposal of materials discussed in this guide may vary significantly from port to port, both within the United States and abroad. Reasons for this variation include the decentralized nature of port control, state, and local environmental regulations, and the local availability of landfill or treatment facilities. Users of this guide should consult local authorities to obtain information on specific legal requirements.

5. Procedure

5.1 *Planning*—Objectives for the waste management audit should be established at the planning stage. A well-planned audit will focus on target materials in critical locations to minimize audit costs. Waste management audits, therefore, should be performed by environmental, health, and safety experts familiar with the specific objectives of the audit. Past audit reports of the area and other documentation that may provide insight into material characterization should be reviewed to avoid the expense of unnecessary tests. For example, construction specifications may characterize a particular material, eliminating the need for testing. In some instances, inspection of the ship or interviews with personnel on-site may be beneficial in planning the audit.

5.2 *Testing*—Many materials will require sampling and characterization tests. A sampling plan should be followed by qualified and authorized personnel. Analysis performed by a qualified or certified laboratory may be required.

6. Potential Shipboard Generated Wastes

6.1 *Asbestos:*

6.1.1 *Description*—Asbestos is the common name of a number of substances including amosite, anthrophyllite, amphibole, and chrysotile (**1**).[6] When asbestos becomes friable, it may be inhaled or swallowed, penetrating body tissues and remaining there for many years. Exposure to asbestos has been linked to asbestosis, mesothelioma, and other cancers. Exposure to cigarette smoke may increase the long-term risk of developing asbestos-related lung cancer by as much as 90 %.

6.1.2 *Uses*—Many common construction products contain asbestos, although use of the material in the United States was significantly reduced during the 1970s. Likely products include pipe lagging and other types of insulation, vinyl tile and linoleum, floor tile adhesives, cement sheet and fiberboard, brake pads and linings, and gasket materials, particularly for high-temperature applications.

6.1.3 *Test Methods (for Thermal Insulation)* (**2**):

6.1.3.1 *Sampling*—The area to be sampled should be subdivided into homogeneous areas, and sampling of each homogeneous area should be conducted in a statistically random manner. For surface materials, collect at least three samples for each area under 1000 ft^2, at least five for areas between 1000 and 5000 ft^2, and at least seven for each area greater than 5000 ft^2. For piping insulation, collect at least three samples from each homogeneous section of piping.

6.1.3.2 *Analysis*—Samples should not be composited for analysis. Analysis of each sample should be conducted using the Polarized Light Microscopy Method described in EPA 600/M4-82-020. Under current U.S. regulations, a homogeneous area may be considered free of asbestos if all samples from that area are shown to contain less than 1 % of asbestos.

6.1.4 *Handling Precautions* (**3**)—Asbestos should only be handled by trained personnel. If asbestos must be disturbed, the area should be isolated and well-labeled to protect employees not involved with the removal or repair work. Protective clothing including disposable coveralls, gloves, goggles, and a respirator should be worn when handling asbestos, and personnel should remove contaminated clothes and wash before leaving the work site. Material should be kept wet to minimize potential for airborne fibers. Waste products should be stored in plastic bags in a sealed rigid container and protected from physical damage. Asbestos material, including asbestos waste, should be stored in an isolated, regulated, and well-marked area. Smoking, eating, drinking, chewing, or applying cosmetics should be avoided in areas in which asbestos exposure is likely. Practice E849 provides additional details. Asbestos replacement materials also may pose environmental, safety, and health risks.

[6] The boldface numbers in parentheses refer to the list of references at the end of this standard.

6.2 *PCB-Contaminated Media:*

6.2.1 *Description*—PCBs have many useful properties including high stability, low vapor pressure, low flammability, high heat capacity, and low electrical conductivity. They are suspected carcinogens, however, and have been associated with adverse health and reproductive effects. They also have a high potential for bioaccumulation in the food chain. A number of trade names exist for PCBs, including Aroclor, Asbestol, Chlorextol, Diaclor, and Dykanol (**4**).

6.2.2 *Uses*—Because of the many positive characteristics of PCBs, oils containing PCBs have been used in a great variety of applications. The most common use has been as a dielectric fluid in transformers, capacitors, and other electrical equipment. The oil also has been used in many other situations including hydraulic equipment, paints, oil-soaked gasket material, and as a plasticizer in many other products. PCBs have been banned in the United States since the mid-1970s, but materials manufactured after the ban have been found to contain them. Applications involving mobile forms of PCBs pose a much greater risk to personnel and the environment. Typical shipboard materials that may contain mobile forms of PCBs include electrical equipment containing dielectric fluid, oil-soaked gasket material, oil-soaked insulation material, and hydraulic fluids.

6.2.3 *Test Methods:*

6.2.3.1 *Sampling*—Because of significant variation in the PCB content of similar materials, mixing or combining samples prior to analysis is not recommended. Similarly, random samples cannot prove untested items either to contain or to be free of PCBs. Liquid oils may be sampled using Practices D923.

6.2.3.2 *Analysis*—Materials may be analyzed using EPA SW-846, Method 8080.

6.2.4 *Handling Precautions*—PCBs should only be handled by trained personnel. Protective equipment should be worn when handling PCBs, with particular attention to avoiding skin and respiratory exposure. Work spaces should be well ventilated (**3**).

6.3 *Refrigerants:*

6.3.1 *Description*—Refrigerants present similar health and environmental dangers and may be discussed as a group. Many refrigerants are ozone-depleting substances. In general, refrigerants are relatively safe and stable gases, but may displace oxygen to dangerously low levels when released into confined spaces. Some refrigerants also may have acute toxic effects or result in increased cardiac sensitization at high concentrations.

6.3.2 *Uses*—A number of chemicals are used as refrigerants in shipboard air conditioning or refrigeration systems. Almost all are halocarbons, with CFC 12 and HCFC 22 being the most common of the traditional refrigerants. Concern for the ozone-depleting potential of these substances has led to the introduction of another common refrigerant, HFC 134a.

6.3.3 *Test Methods*—Identification of materials typically will not require testing. A quick review of system technical manuals should reveal the refrigerant used in the system, and any bottles containing refrigerant gas should be labeled.

6.3.4 *Handling Precautions*—Work on air conditioning and refrigeration systems should be performed only by qualified personnel. Refrigerants should not be intentionally released to the atmosphere. Refrigerants present in air conditioning or refrigeration equipment should be recovered and recycled (refrigerants typically have a high resale or recycling value), as described in ASHRAE Guideline 3. If accidental release occurs, personnel should leave the area and avoid inhaling vapors. Personnel requiring emergency medical attention following inhalation of refrigerants should not be given catecholamine drugs, such as epinephrine, because of the potential for increased cardiac sensitization. As a result of possible toxic by-products of combustion, refrigerants should be kept away from open flame. Smoking should not be allowed in areas in which refrigerants may leak to the atmosphere.

6.4 *Used or Waste Oils:*

6.4.1 *Description*—Waste oils include a variety of oil products that have been contaminated through use or storage to the point at which they can no longer be used for their intended purpose. Many used oils can be recycled. This category does not include water contaminated with small amounts of oil, which is addressed in 6.7.

6.4.2 *Uses*—The primary sources of shipboard used or waste oils are from hydraulic systems, engine room machinery, lubricating systems, and fuel systems.

6.4.3 *Test Methods*—Tests for halogen content and flash point are the most common, but test procedures will vary depending on the intended disposal method and suspected contaminants.

6.4.4 *Handling Precautions*—Recycling may include processes, such as reclamation, burning for energy recovery, reprocessing, or re-refining. The recycling potential of a used oil product will be dependent on the quantity of contaminants present. Contaminants may include arsenic, cadmium, chromium, lead, PCBs, sulfur, hydrogen sulfide, or halogens (chlorine, fluorine, and bromine). Unusually low flash points also may limit recycling potential, as will the presence of dispersants or emulsifying agents. Table 1 summarizes potential recycling problems associated with a variety of common oil products.

6.5 *Paint Products:*

6.5.1 *Description*—Paint often contains toxic constituents. Intact paint typically poses little risk, but exposure to toxic materials may occur during spraying, sanding, grinding, burning, or abrasive blasting procedures with paints containing even trace amounts of toxic chemicals. Potential toxic constituents in paint include fluoride salts and compounds of heavy metals. Toxic organic compounds such as benzene and toluene may be present in paint solvents. Toxic constituents are a

TABLE 1 Potential Recycling Problems Associated with a Variety of Common Oil Products

Product	Potential Problems
Aviation fuels	Low flash point, fire hazard
Refrigeration lubricants	Halogenated hydrocarbon
Tank slops (from tank cleaning)	Detergents/emulsifiers
Grease (from trap cleaning), sludges	Will not dissolve
Oily wastes: waste oil sludge, waste fuel oil, waste lubricant	Hazardous contaminants
Synthetic oil	Incompatible with petroleum products

concern because of the need to protect those applying or disturbing paint and because of disposal concerns associated with paint chips and contaminated blast grit. Paint found on older ships is of particular concern, as many layers of paint may be found in a single location.

6.5.2 *Uses*—Not applicable.

6.5.3 *Test Methods*—Old paint, applied to surfaces, may require analysis to determine toxic content before disturbing it.

6.5.3.1 *Sampling*—Care should be taken to ensure that samples are representative of the material being sampled. A representative sample should include all layers of paint.

6.5.3.2 *Analysis* (**5**)—While laboratory methods can determine the total quantity of toxic constituents in the paint, the capacity for the toxic constituents to leach out into the surrounding environment may be determined using the Toxicity Characteristic Leachate Procedure, EPA SW-846, Method 1311.

6.5.4 *Handling Precautions*—Virtually all paint products contain some toxic constituents. Even small amounts of toxic materials present in paint coatings can result in some airborne exposure during spraying, sanding, grinding, burning, or abrasive blasting procedures, so protective equipment, including respirators and disposable clothing, should be used consistently to minimize risk to personnel, and work areas should be cleaned and well ventilated to remove any contaminated dust or debris (**6**). Dust, debris, and other waste materials with a high leachable toxic content may pose a long-term disposal problem as a result of potential contamination of landfills and groundwater near the disposal site.

6.6 *Cleaning Products:*

6.6.1 *Description*—Many cleaning products contain toxic chemicals. In some cases, large doses of these chemicals would be required for any adverse effect to human health, but some exposure paths require only small quantities of a chemical. Also, some cleaning products may interfere with the operation of oily water separators or sewage treatment equipment. For example, many detergents reduce the effectiveness of shipboard oily water separators. Also, sewage treatment plants using microbes to break down waste products can be damaged by the use of even small quantities of toxic materials.

6.6.2 *Uses*—Household cleaners, industrial solvents, and other cleaning products are found throughout most ships.

6.6.3 *Test Methods*—In most cases, cleaning products will be labeled clearly, making analysis unnecessary.

6.6.4 *Handling Precautions*—Specific handling and disposal instructions should be available through the manufacturer. Check for technical information, such as an MSDS.

6.7 *Oily Water:*

6.7.1 *Description*—Oily water is comprised primarily of oil and water, typically less than 5 % oil, but may contain other contaminants.

6.7.2 *Uses*—Sources for shipboard oily water include tank cleaning wastes, dirty ballast water, and water collecting in bilge spaces.

6.7.3 *Test Methods*—In some locations, tests are performed to determine the disposal requirements for oily water. If the oily water is suspected of containing solvents or other contaminants, the following tests are typically performed (others may be required): flash point, lead, zinc, tin, mercury, and carcinogenic materials.

6.7.4 *Handling Precautions*—The separation of a pure oil/water mixture is a relatively simple process, resulting in water of a high enough quality to be reintroduced into the environment in some locations and oil of a high enough quality to be burned for energy recovery. The presence of lead, mercury, or other toxic contaminants in the mixture may restrict disposal options, and the presence of emulsifying agents or detergents in the mixture may impair the separation process.

6.8 *Soiled Rags:*

6.8.1 *Description*—Rags used to clean any surface contaminated with oils, greases, solvents, or paints. Soiled rags are most often generated in machinery rooms, but also may be generated during maintenance on deck gear or in habitability areas.

6.8.2 *Uses*—Not applicable.

6.8.3 *Test Methods*—Not applicable.

6.8.4 *Handling Precautions*—Soiled rags should be bundled and carefully stored for disposal ashore. Rags soaked with oils, solvents, or paints may be highly flammable and have been known to combust spontaneously. Soiled rags should be stored in sealed containers in well-ventilated spaces and kept away from flame and high temperatures to minimize risk of fire.

6.9 *Chemically Treated Water:*

6.9.1 *Description*—Chemicals are often added to alter the water quality. These may include deoxidizing agents, such as hydrazine or sodium sulfate, added to minimize corrosion. Water also is treated with chemicals, such as lime, to reduce water hardness and prevent fouling. Ethylene glycol often is added to prevent water from freezing.

6.9.2 *Uses*—Most chemically treated water is found in boilers, condensers, and jacket water-cooling systems. Semipermanent ballast water may also contain chemical additives.

6.9.3 *Test Methods*—Inspection of maintenance records should reveal chemical treatments used on the ship, eliminating the need for testing under most circumstances.

6.9.4 *Handling Precautions*—Options for discharge or disposal of chemically treated water may be restricted based on local discharge regulations or agreements. A high concentration of dissolved chemicals in the water may limit disposal options, as municipal water systems, which often eventually receive chemically treated water, typically prohibit certain contaminants. Table 2 and Table 3 provide additional information on common contaminants and their effect on water systems.

6.10 *Firefighting Agents:*

6.10.1 *Description*—Firefighting agents can be one of two general types. Streaming agents typically are handheld units used to direct the material at a fire source and usually are found in small canisters located throughout the ship. Flooding agents are typically installed systems designed to provide a large quantity of material throughout an area in which a fire is occurring and usually are found in large quantities in a central location with piping systems carrying the agent to distribution points.